PAM2861

1.5A LED Driver with Internal Switch

Features

- Simple low parts count
- Internal 40V NDMOS switch
- 1.5A output current
- Single pin on/off and brightness control Using DC voltage or PWM
- Internal PWM filter
- Soft-start
- High efficiency (up to 95%)
- Wide input voltage range: 6V to 40V
- Output shutdown
- Up to 1.5MHz switching frequency
- Inherent open-circuit LED protection
- Typical 4% output current accuracy
- Pb-free SOT23-5, SOT89-5 and MSOP-8 Packages

Applications

- Low voltage halogen replacement LEDs
- Automotive lighting
- Low voltage industrial lighting
- LED back-up lighting
- Illuminated signs

Description

The PAM2861 is a continuous mode inductive step-down converter, designed for driving single or multiple series connected LEDs efficiently from a voltage source higher than the LED voltage. The device operates from an input supply between 6V and 40V and provides an externally adjustable output current of up to 1.5A. Depending upon supply voltage and external components, this can provide up to 30 watts of output power.

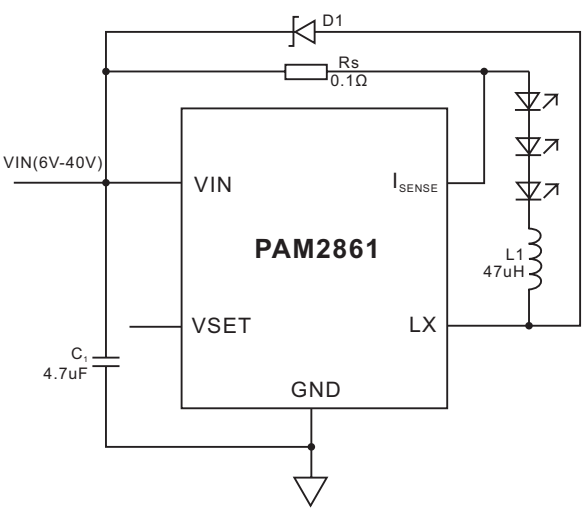
The PAM2861 includes the output switch and a high-side output current sensing circuit, which uses an external resistor to set the nominal average output current.

Output current can be adjusted below the set value, by applying an external control signal to the VSET pin.

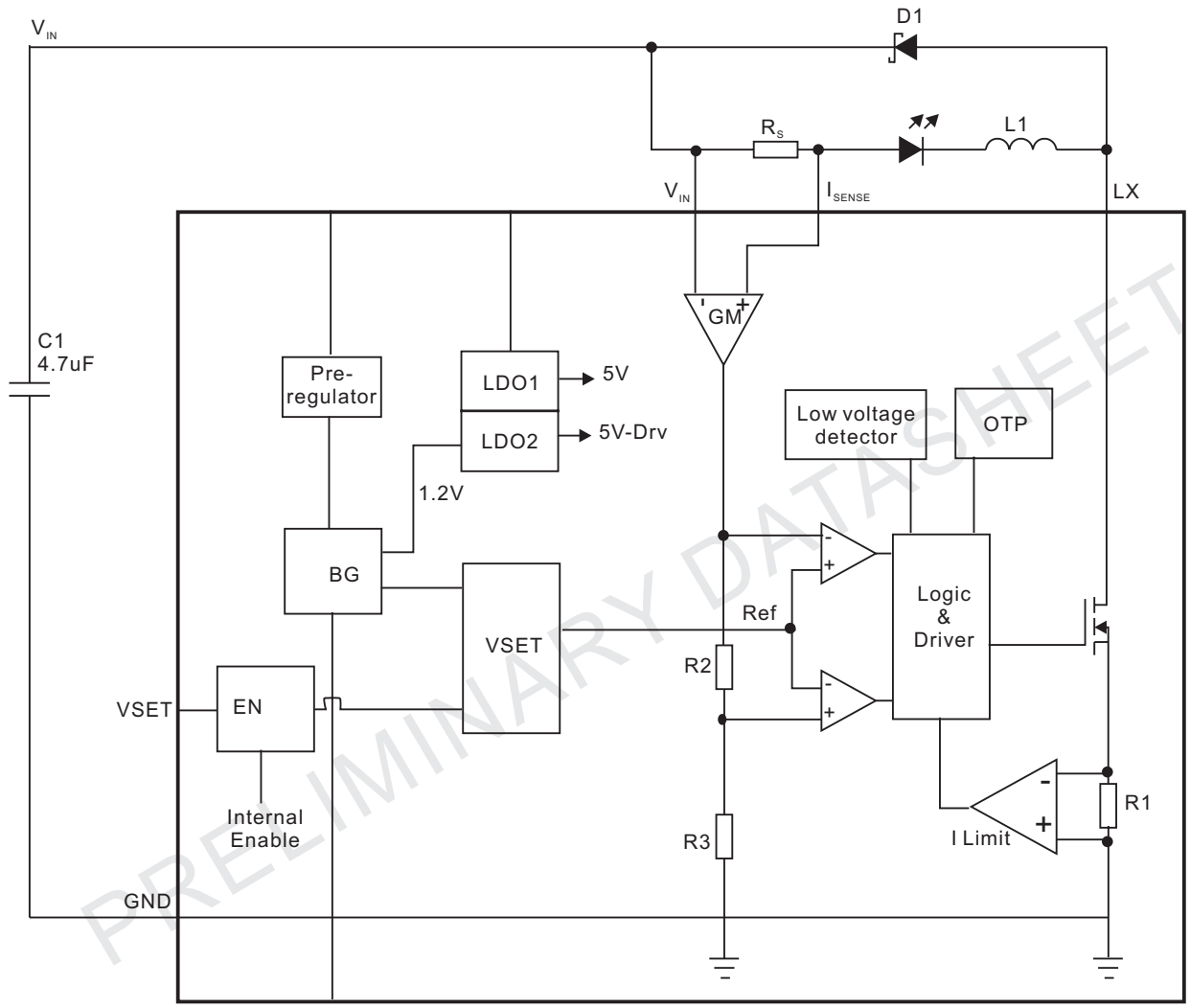
The VSET pin will accept either a DC voltage or a PWM waveform.

The PWM filter provides a soft-start feature by controlling the rise of input/output current. The soft-start time can be increased using an external capacitor from the VSET pin to ground. Applying a voltage of 0.35V or lower to the VSET pin turns the output off and switches the device into a low current standby state.

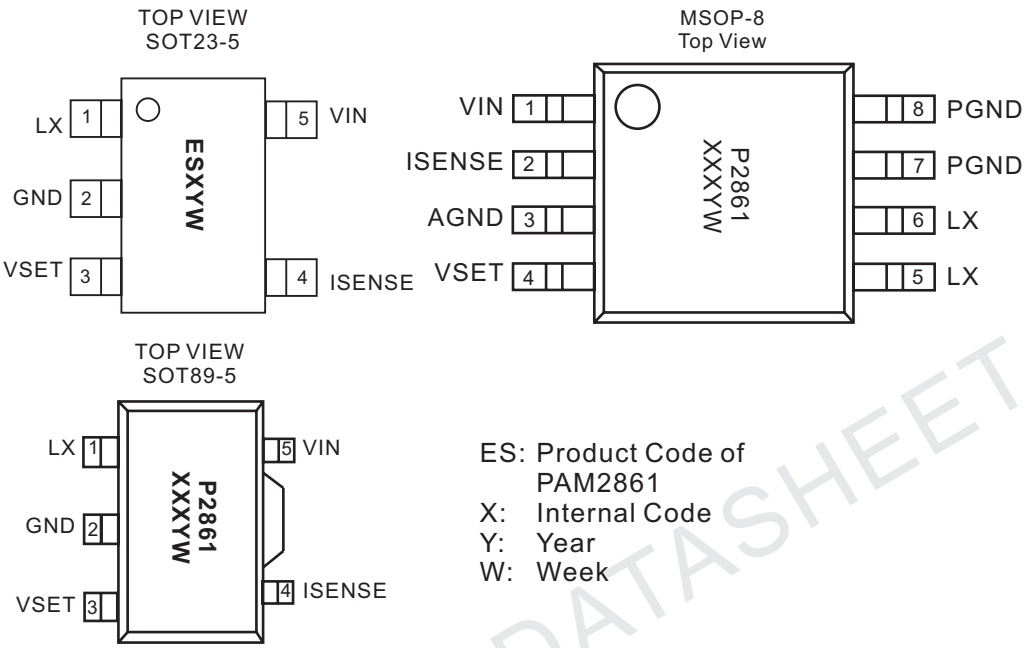
Typical Application



Block Diagram



Pin Configuration



ES: Product Code of PAM2861
X: Internal Code
Y: Year
W: Week

Pin Descriptions

Pin Number		Name	Description
SOT23-5/ SOT89-5	MSOP-8		
1	5, 6	LX	Drain of NDMOS switch.
2		GND	Ground (0V)
	3	AGND	Analog Ground
	7, 8	PGND	Power Ground
3	4	VSET	Multi-function On/Off and brightness control pin: • Leave floating for normal operation. • Drive to voltage below 0.1V to turn off output current • Drive with DC voltage (0.4V < VSET< 2.4V) to adjust output current from 16% to 100% of I_{OUT}nom • Drive with PWM signal from open-collector or open-drain transistor, to adjust output current. Adjustment range 1% to 100% of I_{OUT}nom for f < 500Hz • Connect a capacitor from this pin to ground to increase soft-start time. (Default soft-start time = 0.1ms. Additional soft-start time is approx.1.5ms/nF)
4	2	I_{SENSE}	Connect resistor RS from this pin to VIN to define nominal average output current I_{OUT}nom = 0.1/Rs (**Note:** RSMIN = 0.1_ with VSET pin open-circuit)
5	1	V_{IN}	Input voltage (6V to 40V). Decouple to ground with 4.7_F or higher X7R ceramic capacitor close to device.

Absolute Maximum Ratings

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

Input Voltage Range.....-0.3V to 40V
LX, ISENSE Pin voltage.....-0.3V to 40V
ENPin voltage.....-0.3V to 6V
Maximum Junction Temperature.....150℃
Operation Junction Temperature.....-40℃ to 125℃
Storage Temperature.....-65℃ to 150℃
Soldering Temperature.....300℃,5sec

Recommended Operating Conditions

Input Voltage Range.....6V to 40V
Operation Temperature Range.....-40℃to 105℃

Thermal Information

Parameter	Package	Symbol	Maximum	Unit
Thermal Resistance (Junction to Ambient)	SOT23-5	θjA	250	℃/W
	SOT89-5		180	
	MSOP-8		180	
Thermal Resistance (Junction to Case)	SOT23-5	θjC	130	
	SOT89-5		100	
	MSOP-8		75	

Electrical Characteristic

T_A=25°C, V_{IN}=16V, unless otherwise noted.

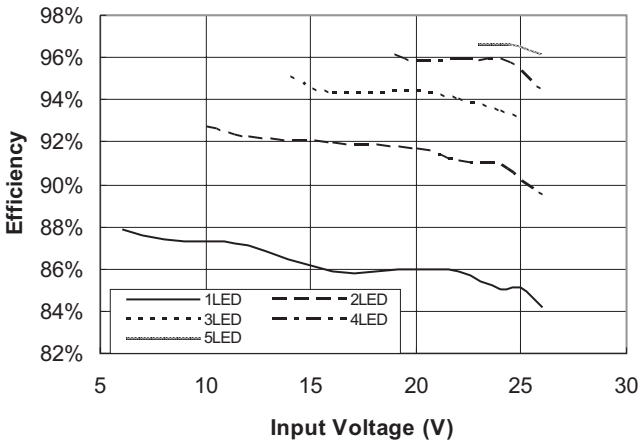
Parameter	Symbol	Condition	Min	Typ	Max	Units
Input voltage	Vin		6	16	40	V
Output current	ILED		80	350/1000	1500	mA
Shutdown current	Isd	EN pin grounded		10	20	μA
Quiescent current with switching	IQ	EN pin floating, fsw = 330kHz		1	3	mA
Mean current sense threshold voltage	Vsense	Measured on Isense pin with respect to vin	95	100	105	mV
Sense threshold hysteresis	Vsense_hys		10	15	25	%
Isense pin input current	Isense	Vsense = Vin – 0.1		3.5		μA
Internal reference voltage	Vref	Band-gap voltage		1.204		V
Temperature coefficient of Vref	Vref/T			50		ppm/°C
Vset range on EN pin	Ven	For DC dimming	0.4		2.4	V
DC voltage on EN pin to enable	Venon	Ven rising	0.4			V
DC voltage on EN pin to disable	venoff	Ven falling			0.38	V
LX switch on resistance	RLX	@ILX=100mA		0.3		Ω
LX switch leakage current	ILX(leak)				5	μA
Soft start time	Tss	Vin=16V, Cen = 1nF		1.5		ms
Operating frequency	FLX	Vi=16V, Vo=9.6V (3 LEDS), L=47μH, I=0.25A (ILED=1A)		233		kHz
Recommended minimum switch ON time	Ton_rec	For 4% accuracy		500		ns
Recommended maximum switch frequency	FLXmax				1.5	MHz
Max duty circle					100	%
Recommended duty cycle range	DLX		25		75	%
Internal comparator propagation delay	TPD*			30		ns
Over temperature protection	TOTP			170		°C
Temp protection hysteresis	TOTP_hys			40		°C
Current limit	IXLmax	Peak inductor current		1.7		A

*parameters are not tested at production, but guaranteed by design.

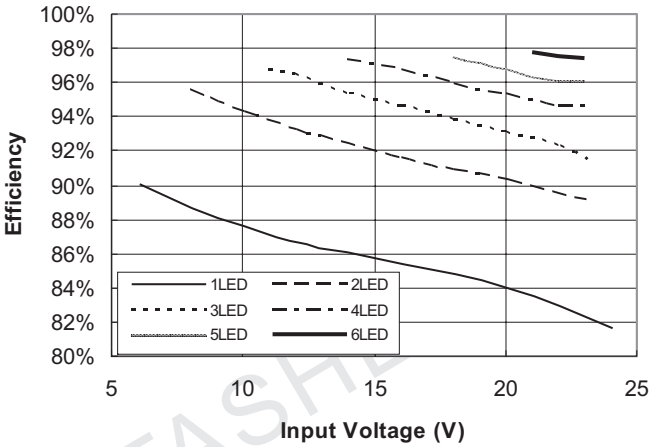
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

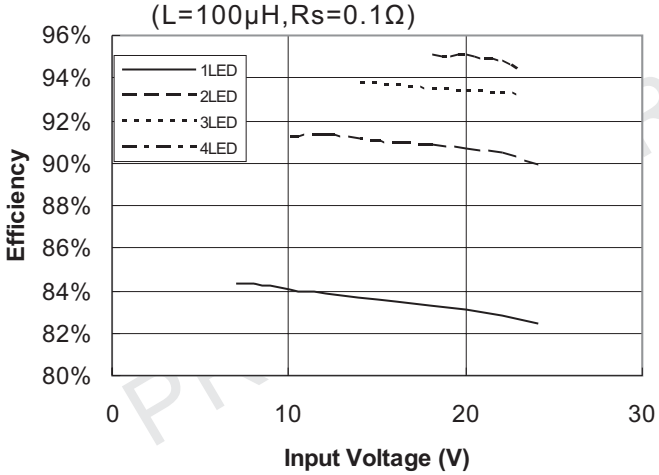
1. Efficiency vs Input Voltage (L=47μH,Rs=0.1Ω)



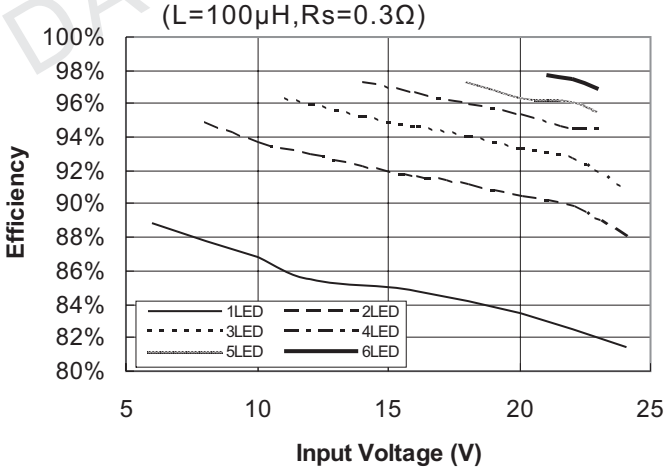
2. Efficiency vs Input Voltage (L=47μH, Rs=0.3Ω)



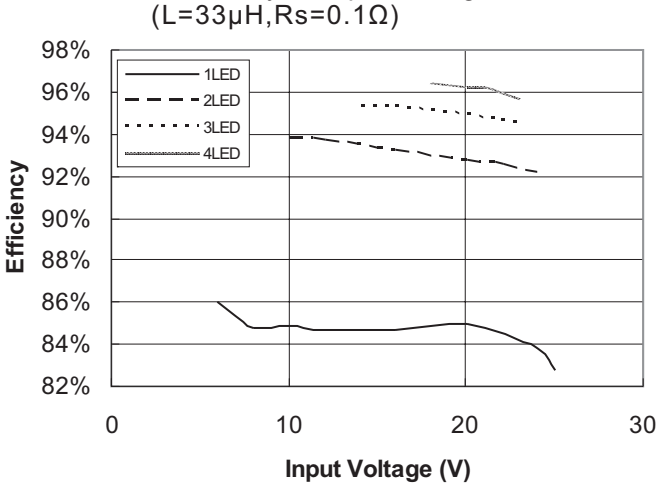
3. Efficiency vs Input Voltage (L=100μH,Rs=0.1Ω)



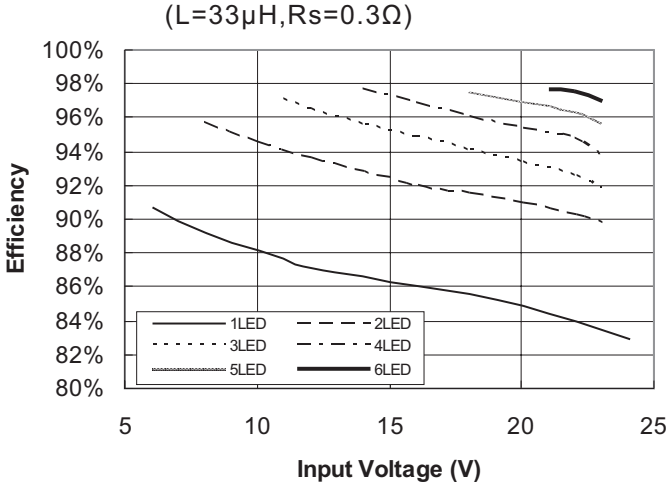
4. Efficiency vs Input Voltage (L=100μH,Rs=0.3Ω)



3. Efficiency vs Input Voltage (L=33μH,Rs=0.1Ω)



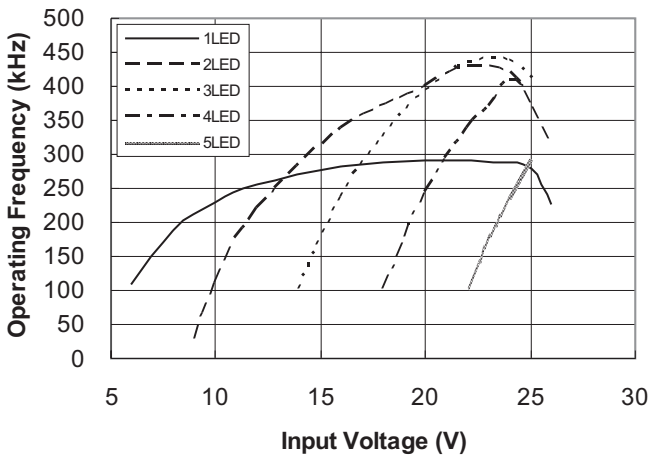
4. Efficiency vs Input Voltage (L=33μH,Rs=0.3Ω)



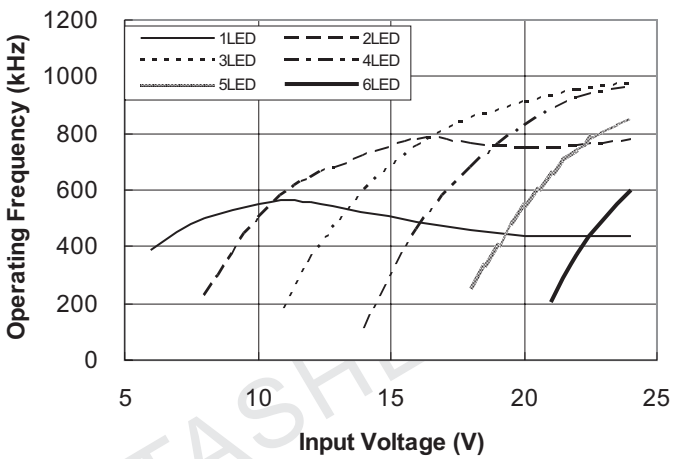
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

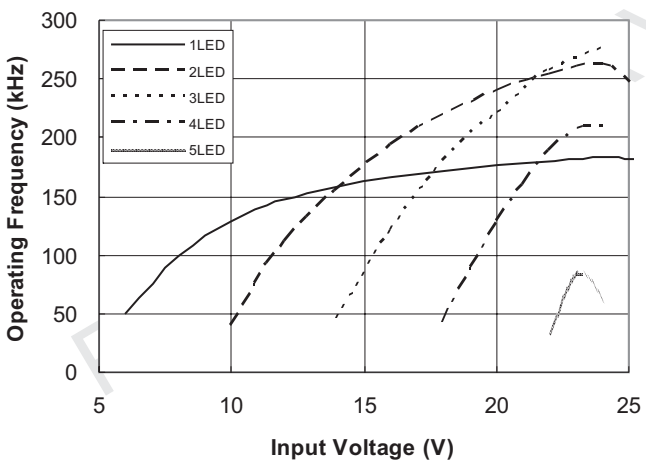
7. Operating Frequency vs Input Voltage (L=47μH,Rs=0.1Ω)



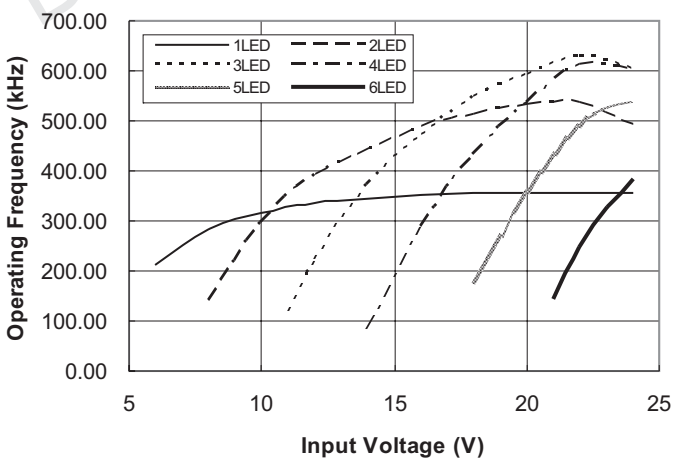
8. Operating Frequency vs Input Voltage (L=47μH,Rs=0.3Ω)



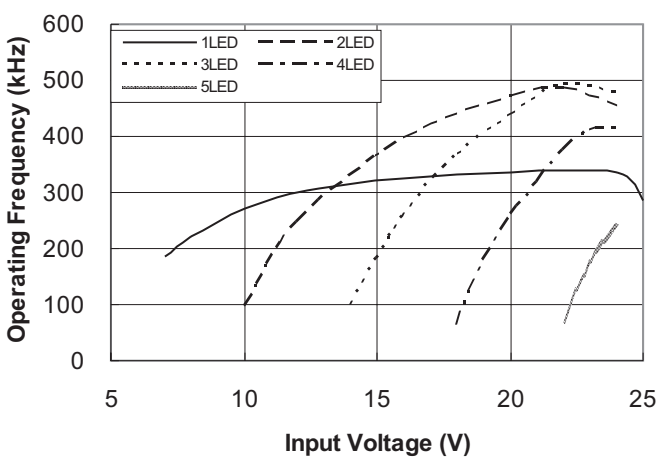
9. Operating Frequency vs Input Voltage (L=100μH,Rs=0.1Ω)



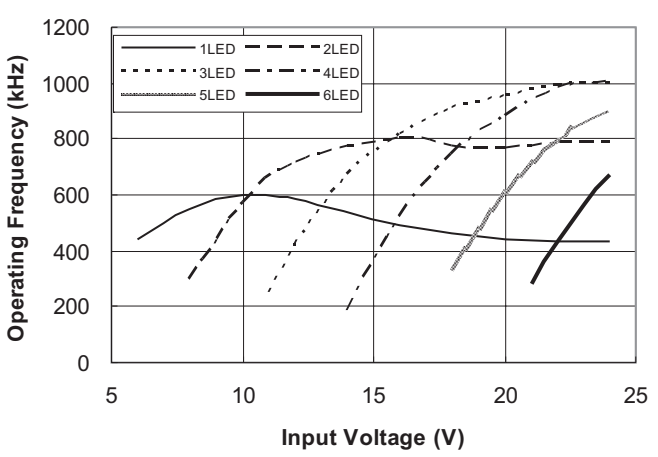
10. Operating Frequency vs Input Voltage (L=100μH,Rs=0.3Ω)



11. Operating Frequency vs Input Voltage (L=33μH,Rs=0.1Ω)



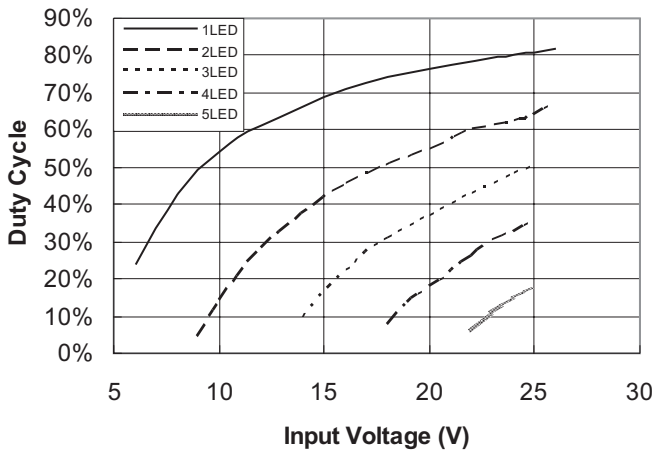
12. Operating Frequency vs Input Voltage (L=33μH,Rs=0.3Ω)



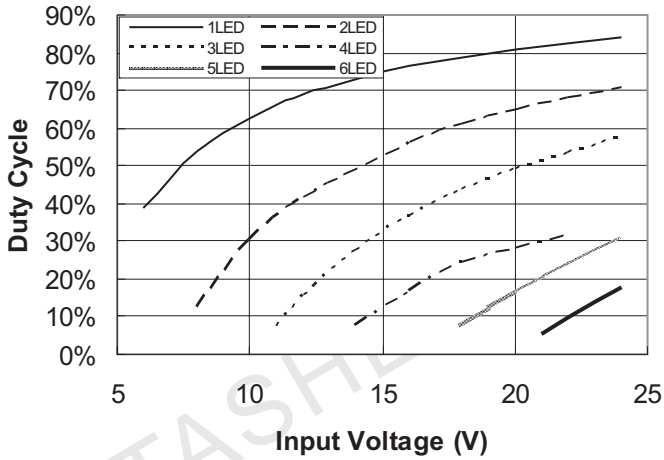
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

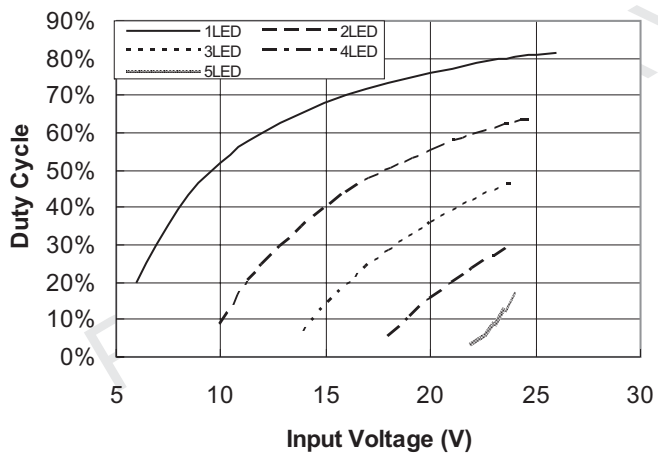
13. Duty Cycle vs Input Voltage (L=47μH,Rs=0.1Ω)



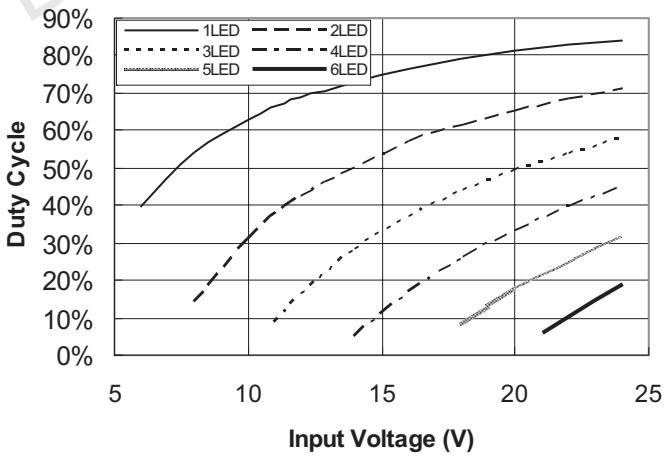
14. Duty Cycle vs Input Voltage (L=47μH,Rs=0.3Ω)



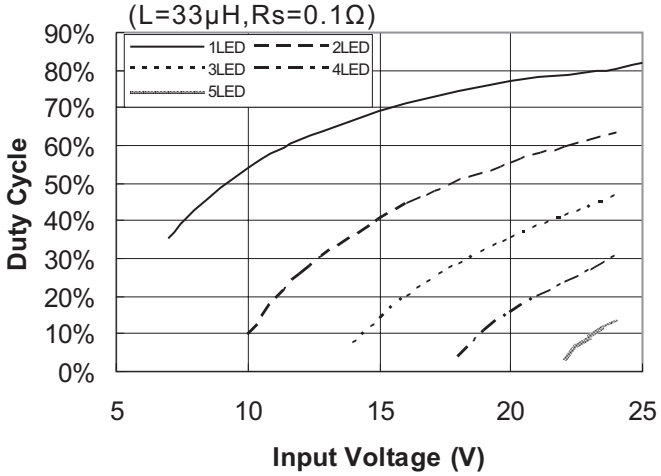
15. Duty Cycle vs Input Voltage (L=100μH,Rs=0.1Ω)



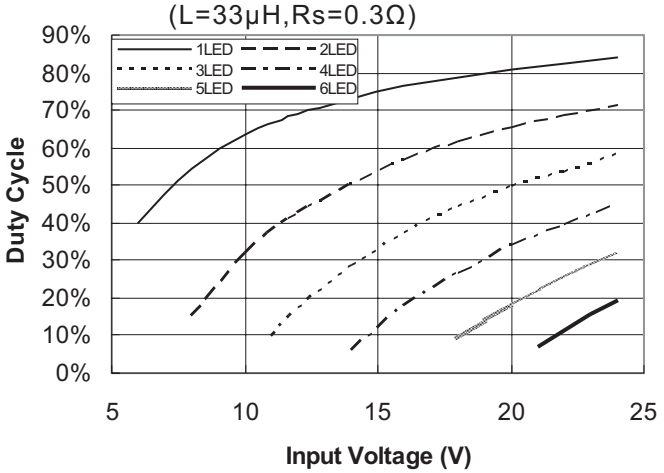
16. Duty Cycle vs Input Voltage (L=100μH,Rs=0.3Ω)



17. Duty Cycle vs Input Voltage (L=33μH,Rs=0.1Ω)



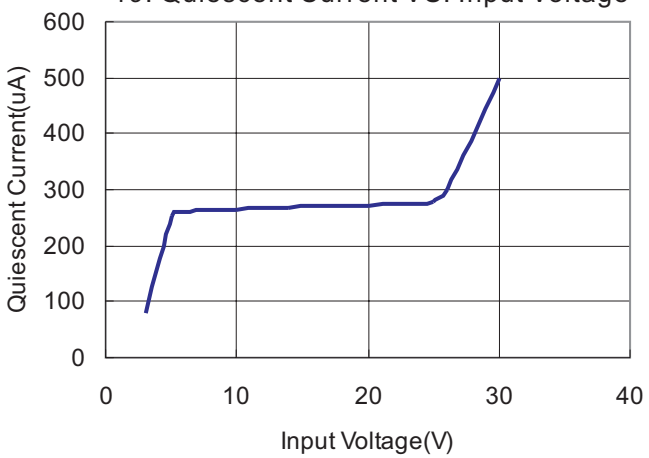
18. Duty Cycle vs Input Voltage (L=33μH,Rs=0.3Ω)



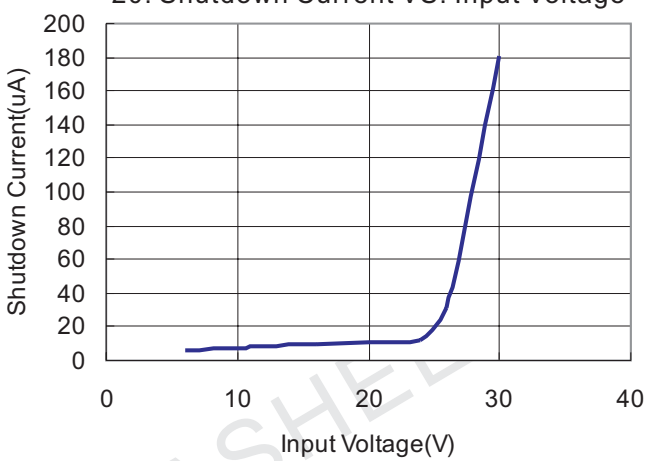
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

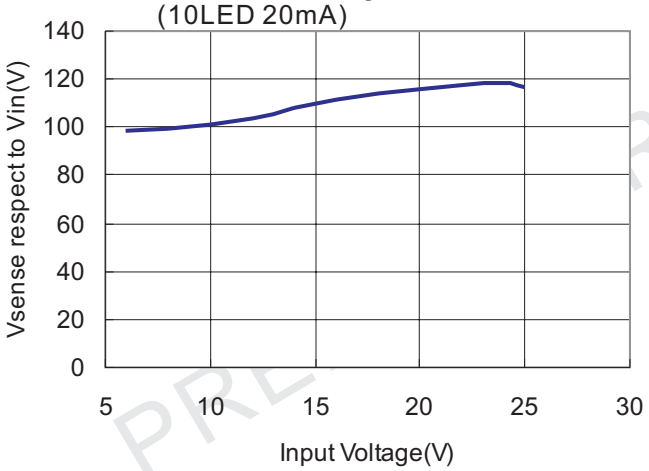
19. Quiescent Current VS. Input Voltage



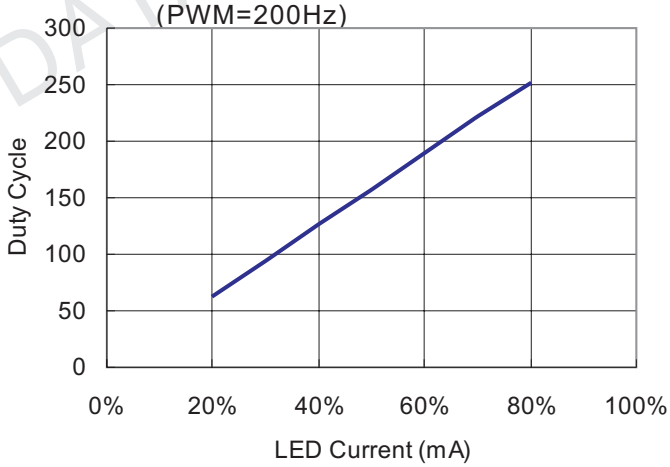
20. Shutdown Current VS. Input Voltage



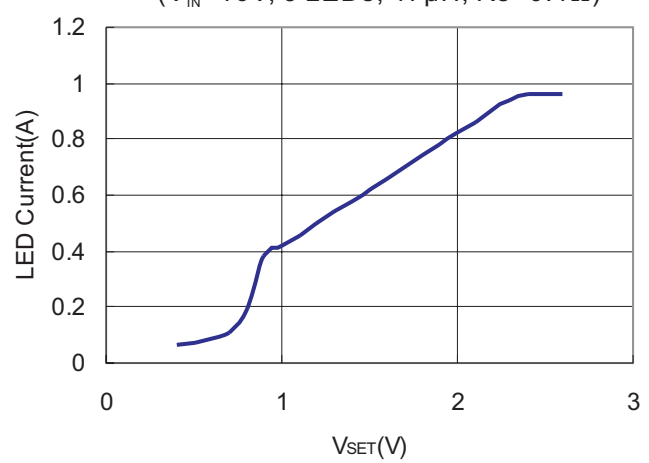
21. Feedback Voltage VS Vin (10LED 20mA)



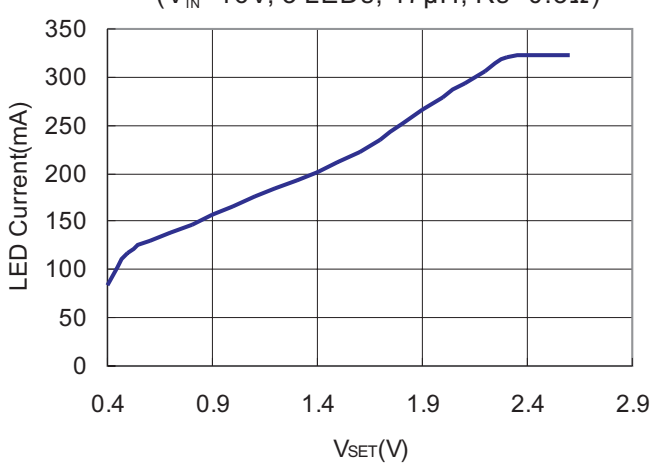
22. Duty Cycle VS LED Current (PWM=200Hz)



23. I_{LED} vs V_{SET} (V_{IN}=16V, 3 LEDs, 47μH, Rs=0.1Ω)



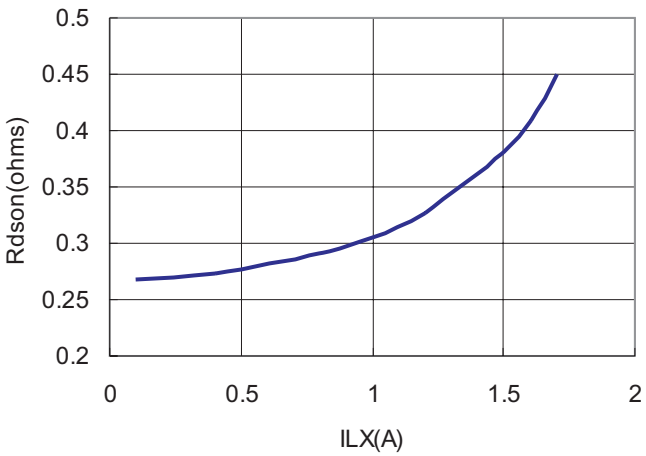
24. I_{LED} vs V_{SET} (V_{IN}=16V, 3 LEDs, 47μH, Rs=0.3Ω)



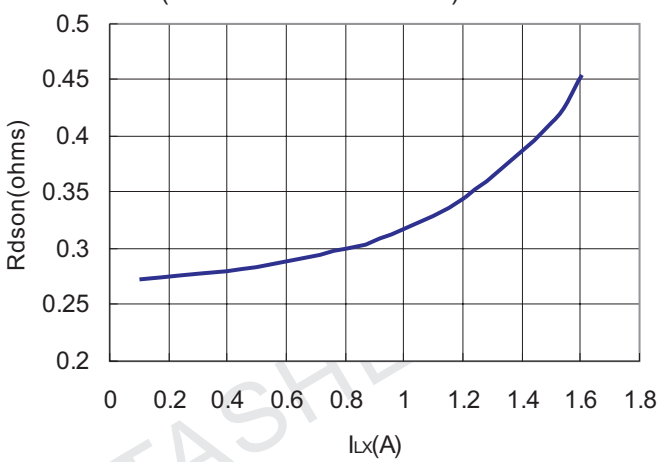
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

25. R_{DSON} vs I_{LX}
(Current Limit is 1.78A)



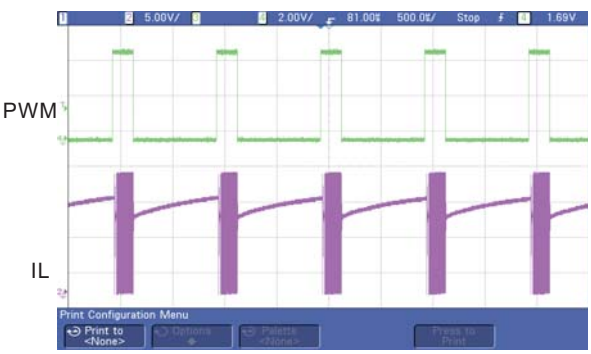
26. R_{DSON} vs I_{LX}
(Current Limit is 1.66A)



27. Steady State Waveforms

28. Start up Waveforms

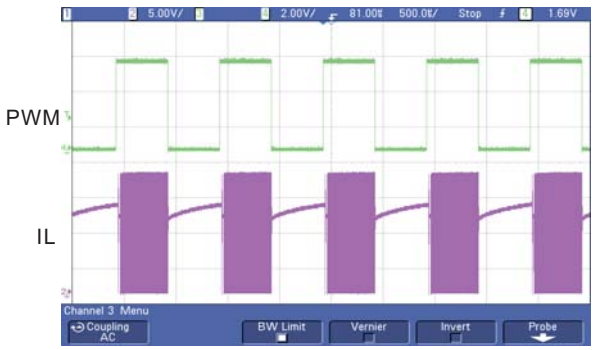
29. Dimming Waveform (PWM=20%)



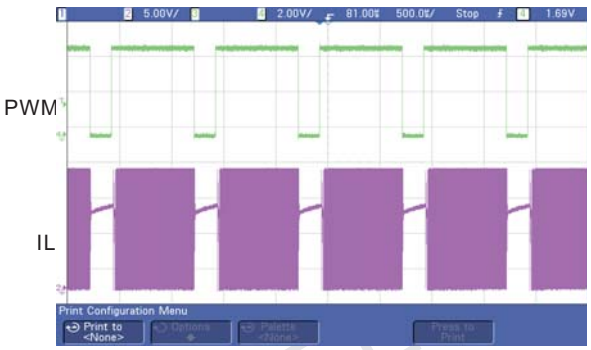
Typical Operating Characteristics

T_A=25°C,V_{DD}=V, unless otherwise noted.

30. Dimming Waveforms (PWM=50%)

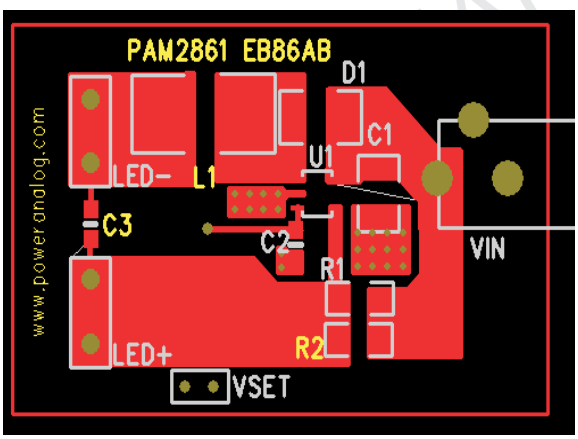


31. Dimming Waveforms (PWM=80%)

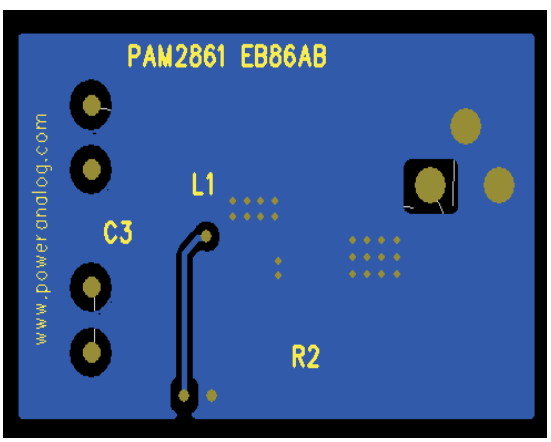


PCB Layout Example

Top

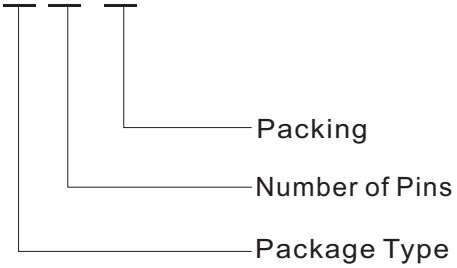


Bottom



Ordering Information

PAM 2861 X X X

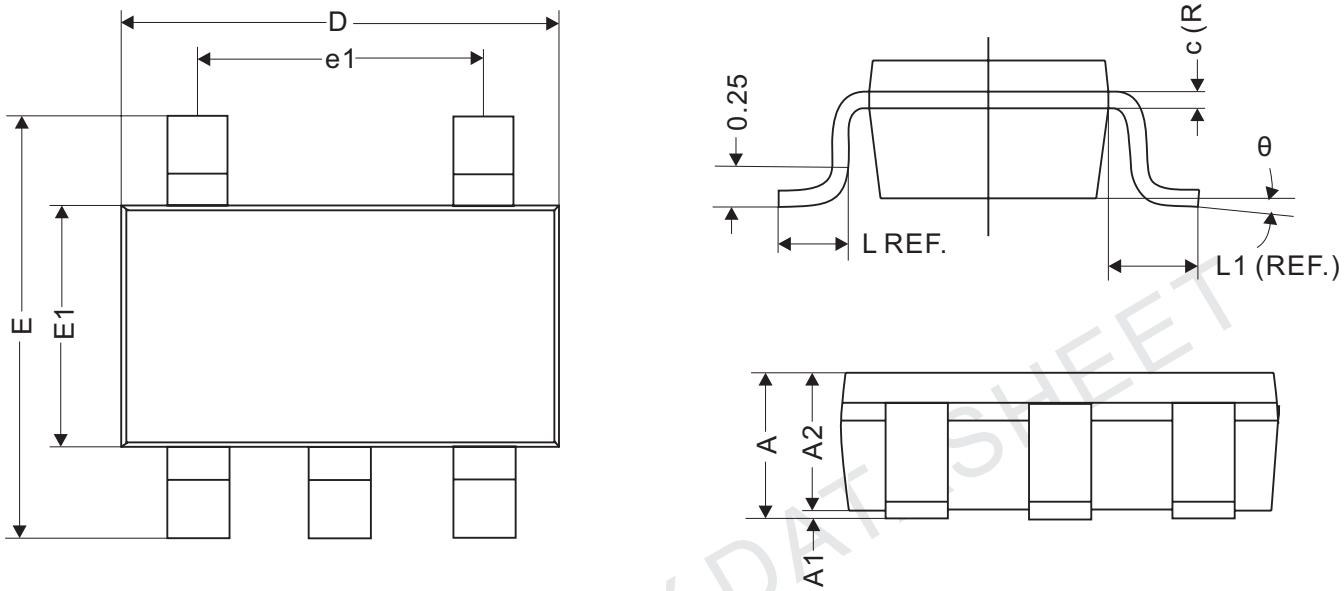


Package Type	Number of pins
A: SOT23 C: SOT89 S: MSOP	B: 5 C: 8

Part Number	Marking	Package Type	MOQ
PAM2861ABR	ESXYW	SOT23-5	3,000 Units/ Tape & Reel
PAM2861CBR	P2861 XXXYW	SOT89-5	1,000 Units/ Tape & Reel
PAM2861SCR	P2861 XXXYW	MSOP-8	2,500 Units/ Tape & Reel

Outline Dimensions

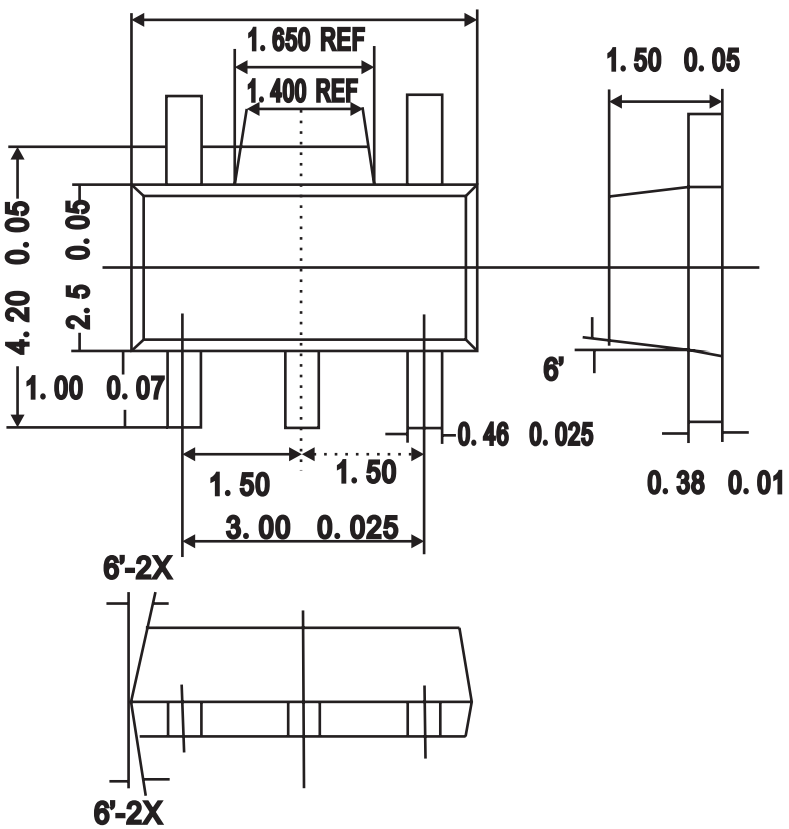
SOT23-5



REF.	Millimeter		
	Min	Nom	Max
A		1.10MAX	
A1	0	0.05	0.10
A2	0.70	1.00	1.295
c		0.12REF.	
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
L		0.45REF.	
L1		0.60REF.	
θ	0°	5°	10°
b	0.30	0.40	0.50
e		0.95REF.	
e1		1.90REF.	

Outline Dimensions

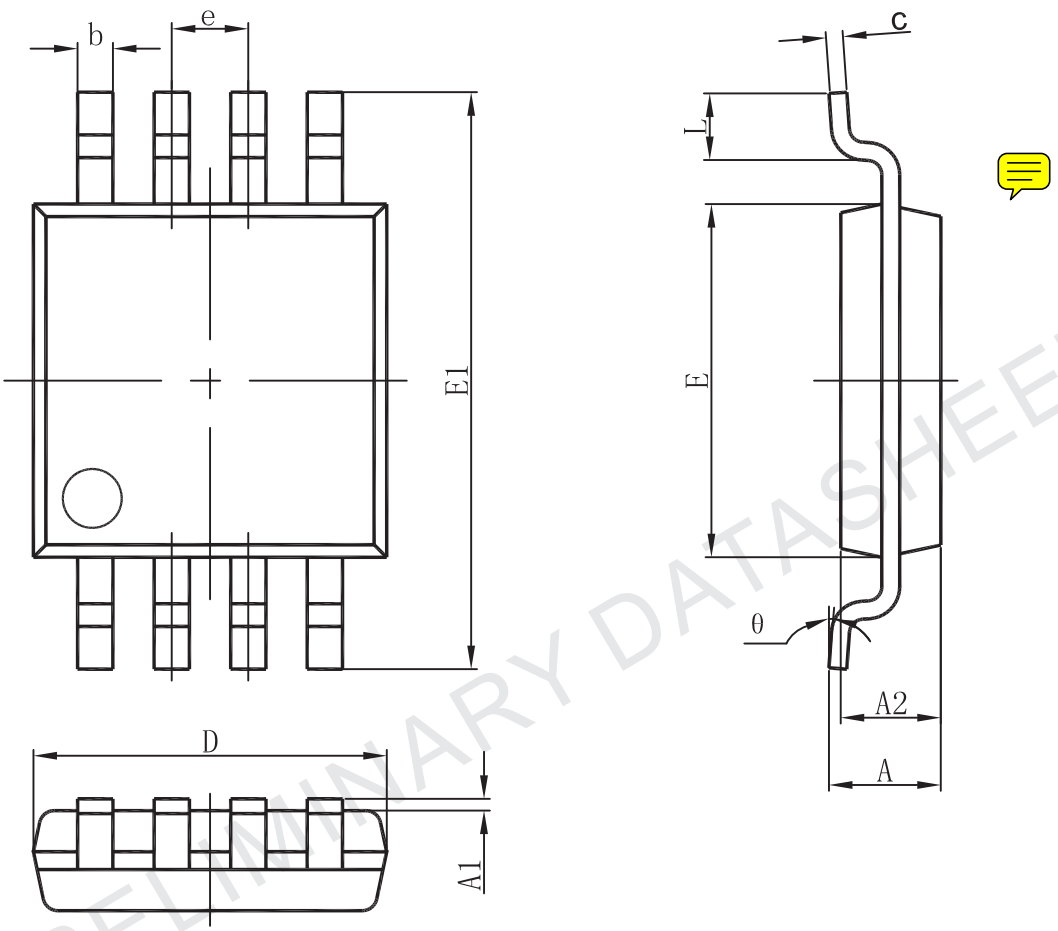
SOT89-5



(Unit: mm)

Outline Dimensions

MSOP8



REF	Millimeter	
	Min	Max
A	--	1.10
A1	0.05	0.15
A2	0.78	0.94
b	0.22	0.38
c	0.08	0.23
D	2.90	3.10
E	2.90	3.10
E1	4.75	5.05
e	0.65BSC	
L	0.40	0.70